Tuesday, November 06, 2012

Toa Baja Landfill
RCRA §7003 Order for Landfill Closure: 4th Q, FY 2012
Environmental Benefit Estimates[1]

Executive Summary

The New Order-mandated closure of the Toa Baja open dump will generate significant and quantifiable environmental benefits not captured under the prior Order:[2]

- Leachate pollutant contaminants restricted from formation:
  - Captured under prior Order

- Leachate collected and treated:
  - Captured under prior Order

- Stormwater pollutant contaminants controlled and treated:
  - Captured under prior Order

- Additional contaminated landfill waste sequestered by capping (10,400,000 cubic yards captured under prior Order):
  - Cost: $0 (captured under prior Order)
  - Complying Action: Reduction of Ongoing Releases
  - Program Category: Hazardous Waste Management
  - Type: Waste Containment
  - Pollutant: Contaminated landfill waste
  - Unit: 4,961,000 cubic yards
  - Media: Soil

- Methane gas captured and burned (58,940,000 pounds/year captured under prior Order):
  - Captured under prior Order

  Note: Alternatively, methane gas treated may be expressed in Greenhouse Gas Equivalents (GHG eq.) at 1,076,009,000 lbs/yr CO_2 eq. net

- Non-Methane gas captured and burned (2,534,000 pounds/year captured under prior Order):
  - Captured under prior Order

- Landfill gas energy recovery (energy recovery):
  - Cost: $0 (captured under prior Order)
  - Complying Action: Reduction of Ongoing Releases

[1] http://www.epa.gov/compliance/resources/publications/data/tools/ccds.pdf, *Guide to Calculating Environmental Benefits of Enforcement Cases – FY2012* was employed for guidance.

[2] Note: In keeping with traditional EPA data entry practices, calculated values were not rounded off to the proper arithmetic precision (2 significant figures for these calculations). Example: 5,385,880,020 pounds of Leachate Minimized would more properly be stated as 5,400,000,000 pounds.

- Program Category: Hazardous Waste Management
- Type: Proper Waste Disposal
- Pollutant: Carbon Dioxide (CO_2)
- Unit: 46,512,000 lbs pounds/year (CO_2 equivalent in greenhouse gas emissions)
- Media: Air

❖ Municipal Waste Recycled:

- Cost: $1,404,000/year
- Complying Action: Reduction of Ongoing Releases
- Program Category: Hazardous Waste Management
- Type:
  - Proper Waste Disposal
- Pollutant:
  - Carbon Dioxide (CO_2)
  - Contaminated landfill waste
- Unit:
  - 206,343,000 lbs pounds/year (CO_2 equivalent in greenhouse gas emissions)
  - 200,116 cubic yards/year
- Media:
  - Soil
  - Air

Note: An alternative, truer lifecycle-based CO_2 equivalent calculation would give the following:

- Unit:
  - 206,343,000 pounds/year (CO_2 equivalent in greenhouse gas emissions)
  - 200,116 cubic yards/year

❖ Photovoltaic System (landfill cap):

- Cost: $1,737,500
- Complying Action: Reduction of Ongoing Releases
- Program Category: Hazardous Waste Management
- Type: Waste Containment
- Pollutant: Carbon Dioxide (CO_2)
- Unit: 1,133,100 pounds/year (CO_2 equivalent in greenhouse gas emissions)
- Media: Air

All calculations are based upon best estimates, given the information available.

1. Landfill Leachate Minimized

Summary

- Captured under prior Order

2. Landfill Leachate Collected and Treated

Summary

- Captured under prior Order

3. Landfill Stormwater Treated

Summary

- Captured under prior Order

4. Contaminated Landfill Waste Contained

Summary

- 10,400,000 cubic yards (yd^3) captured under FY2007 Order
- 4,961,000 yd^3 of contaminated landfill waste will be contained under this FY2012 Order

This environmental benefit comes from the regrading, slope stabilization, and capping of the current open dump, and additional cells, recorded under *Containment*. Contaminated Landfill Waste is a pollutant in the CCDS with soil as the effected media.

Explanation

The solid waste disposed at municipal landfills contains constituents, including toxins and human pathogens, posing risks to human health and the environment. Uncovered/uncapped waste may risk human health through disease vectors (*e.g.*, feral dog packs and birds), human scavenging, and represents a fire risk. Toa Baja is known to accept for disposal more than 4 million pounds of household hazardous waste (*e.g.*, solvents, pesticides, paints and household chemicals) per year. EPA's Toxics Release Inventory ("TRI") reports some 800,000 pounds of chemicals and chemical compounds identified as carcinogenic as having been disposed at the MSWLF Facility since 1987 (the start of TRI tracking).

In addition, Toa Baja Landfill's combination of unstable foundation/bedrock (*i.e.*, karst), location within a seismic zone, and potentially unstable slopes, represent a clear risk to residents with homes located at the base of this landfill.

The prior Order's contaminated landfill waste calculation was based on field volume estimates for the landfill by EPA.

Based on Toa Baja's GCCS Design Plan projections, some 1,503,000 tons of additional solid waste has been and will be disposed in the old cell and the new, lined waste cell to the west under the new Order. Hence, 4,961,000 yd^3 of additional, contaminated landfill waste will be contained under the new Order.[3]

[3] http://www.epa.gov/osw/conserve/downloads/recy-com/appdx_c.pdf A conversion of 3.3 yd^3/ton compacted municipal solid waste was employed.

5. Methane Gas (CH_4) Treated

Summary

- Captured under prior Order

6. Non-Methane Organic Compounds (NMOC) Treated

Summary

- Captured under prior Order

7. Landfill Gas Energy Recovery

Summary

- 46,512,000 lbs pounds/year CO_2 equivalent

The new Order included the design, development, and implementation of a landfill gas energy recovery system. In addition to the above benefits, under Methane Gas and NMOC Treated, this will result in ~90,000,000 pounds carbon dioxide equivalent per year of avoided equivalent emissions reduced through the offset of carbon dioxide from avoiding the use of fossil fuels.

Explanation (CH_4 & NMOC)

Landfill gas is generated during the natural process of anaerobic decomposition of refuse contained in a MSWLF. By volume, landfill gas is about 50% methane and 50% carbon dioxide and water vapor. It also contains small amounts of nitrogen, oxygen, and hydrogen, less than 1% NMOC, and trace amounts of inorganic compounds. A number of factors influence the quantity of gas that a MSWLF generates and the components of that gas. These factors include, but are not limited to, the types and age of the waste buried in the landfill, the quantity and types of organic compounds in the waste, and the moisture content and temperature of the waste. Temperature and moisture levels are influenced by the surrounding climate.

Methane gas is odorless and highly combustible. The accumulation of methane gas within a MSWLF can potentially cause fires and/or explosions. Through subsurface migration, landfill gas can also migrate off-site and pose a further threat to off-site structures or enclosures. Methane is a greenhouse gas that contributes to global climate change and is of particular concern because it is 21 times more effective at trapping heat in the atmosphere than carbon dioxide. Landfills are the largest human-related source of methane in the U.S., accounting for 34% of all methane emissions.[4]

NMOC consist of certain hazardous air pollutants (HAP) and volatile organic compounds (VOC), which can react with sunlight to form ground-level ozone (smog) if uncontrolled. Nearly 30 organic HAPs have been identified in uncontrolled landfill gas, including benzene, toluene, ethyl benzene, and vinyl chloride. Exposure to these HAPs can lead to adverse health effects.

[4] http://www.epa.gov/methane/sources.html

Nonmethane organic compounds are contained in discarded items such as household cleaning products, materials coated with or containing paints and adhesives, and other items. During the waste decomposition process, NMOC can be stripped from the waste by methane, carbon dioxide, and other gases and carried in landfill gas. Three different mechanisms are responsible for the production of NMOC and their movement into landfill gas: (1) vaporization (the change of state from liquid or solid to vapor) of organic compounds until the equilibrium vapor concentration is reached, (2) chemical reaction of materials present in the landfill, and (3) biological decomposition of heavier organic compounds into lighter, more volatile constituents.

Toa Baja Landfill has not in the past nor does it now collect or treat any of the methane or NMOCs generated.

Note: Alternatively, methane gas treated may be expressed in Greenhouse Gas Equivalents (GHG eq.) at a 21:1 ratio were 10,000,000 lbs/yr CH_4 = 210,000,000 lbs/yr CO_2 eq. However, as:

$CH_4 + 2O_2 = CO_2 + 2HO_2$ (ΔH = -891 kJ/mol @STP)

16.04 g/mol + 2x32.00 g/mol = 44.01 g/mol + 2x18.02 g/mol

For every pound of methane burned some 44.01/16.04 or 2.744 lbs of CO_2 is produced. Thus, 58,940,000 lbs/yr CH_4, the amount captured under prior Order, is the equivalent to 1,076,009,000 lbs/yr CO_2.

To calculate the environmental benefits of the fossil fuel replacement, the EPA Landfill Methane Outreach Program (LMOP) *LFG Energy Benefits Calculator* was employed.[5] The LFG Energy Benefits Calculator was used to estimate direct, avoided, and total greenhouse gas reductions, as well as environmental and energy benefits, for the Toa Baja Landfill gas energy project. For both electricity generation and direct–use projects, reductions of greenhouse gas emissions are derived from capturing and destroying landfill methane (already accounted for in the preceding sections). Greenhouse gases are also reduced by the offset of carbon dioxide (CO_2) emissions. Electricity generation projects displace CO_2 that would have otherwise been generated from fossil fuels burned at conventional power plants. For direct-use projects, the methane in LFG displaces fossil fuels and avoids CO_2 that would have otherwise been released.

As the *LFG Energy Benefits Calculator* employs units of LFG in standard cubic feet per minute (scfm), a conversion is needed:

Peak LFG (in 2017)[6] = (3.599 x$10^7$$m^3$/yr) x (35.3147 scf/$m^3$) x (70% eff)

Peak LFG (in 2017) = 889,700,000 scf/year x (year/525,960 min)

Peak LFG (in 2017) = 1,692 scfm

The results in avoided equivalent emissions reduced through the offset of carbon dioxide from avoiding the use of fossil fuels, was 23,256 tons CO_2/yr or 46,512,000 lbs CO_2/yr.

[5] http://epa.gov/lmop/projects-candidates/lfge-calculator.html

[6] From: *Gas Collection and Control System Design Plan for the Toa Baja Municipal Solid Waste Landfill, Toa Baja, Puerto Rico,* Landfill Technologies Corporation, Gurabo, Puerto Rico, Revision 1- July 2012.

Attachment 1 includes the EPA LMOP *Emission Reduction and Environmental and Energy Benefits for Landfill Gas Energy Projects* Summary Report.

8. Municipal Waste Recycled

Summary

- 41,967,000 pounds/year CO_2 equivalent

The Order mandates the development and implementation of a municipal-wide recycling program. When phased in, over several years, this program will divert some 51 million pounds/year of recyclables and 31 million ponds/year of yard waste from the landfill, resulting in a reduction of some of 41,967,000 lbs of carbon dioxide equivalent in greenhouse gas emissions each year from avoided, direct, landfill gas emissions and a total of 206,343,000 lbs of carbon dioxide equivalent reduced based on lifecycle analysis. Two alternative calculation methods were employed, *Lifecycle Calculations* and *Avoided Landfill Gas Emission Calculations*. The above value is from the more limited second alternative.

Explanation

Total population of Toa Baja is 89,609.[7] The total number of Toa Baja households is 32,617 resulting in a Toa Baja-specific household population of 2.75/household.

The daily solid waste generation rate for Puerto Rico has been calculated at 5.56 lbs per person.[8] Recyclable Material composition was determined from the weight fraction of plastics, paper/cardboard, metals, and glass of 42.7% of the solid waste rate.[9]

Employing the Solid Waste Management Authorities (SWMA) base case analysis for achievable municipal recycling (*i.e.*, 35% waste diversion) in Puerto Rico, and excluding the construction debris and not otherwise defined recycling categories, results in a waste recycling/diversion rate of 32.0% counting yard waste and 18.6% without.

The average participation rate in the SWMA base case was 52%. This does not reflect the Order-mandated ban on recyclables in the landfill and the passage of local rules or ordinances authorizing the imposition of penalties or creation of incentives to insure recycling. To reflect these factors, a higher rate of participation 70-82% (averaged as 76%) was employed.[10] Based on these higher rates, when phased in, the Toa Baja recycling program will divert some 50,580,000 lbs/year of recyclables and 30,670,000 lbs/year of yard waste from the landfill.

Alternative 1: Lifecycle Calculations

To calculate the environmental benefits of the mandated recycling and green waste programs, the EPA Waste Reduction Model (WARM) was employed to estimate greenhouse gas (GHG) emission reductions. WARM was created by the EPA to help solid waste planners and organizations estimate greenhouse gas (GHG) emission

[7] http://factfinder2.census.gov/ 2010 Census data for Toa Baja, PR.

[8] *Dynamic Itinerary for Infrastructure Projects Technical Report*, PR-SWA, February, 2007: 4.2.1. Existing Solid Waste Generation.

[9] *Dynamic Itinerary for Infrastructure Projects Technical Report*, PR-SWA, February, 2007: Table 4-1.

[10] Based on personal communication with Mickey Ray, President, The Earth Group, Inc., 20 Sept. 2012.

reductions from several different waste management practices. WARM calculates GHG emissions for baseline and alternative waste management practices, including source reduction, recycling, combustion, composting, and landfilling. The GHG emission factors were developed following a life-cycle assessment methodology. The model calculates emissions in metric tons of carbon dioxide equivalent ($MTCO_2E$) and metric tons of carbon equivalent (MTCE) across a wide range of material types commonly found in municipal solid waste (MSW).

From the WARM Model calculations (based on one year's recycling):

Total GHG Emissions from Baseline MSW Generation and Management ($MTCO_2E$):	13,197
Total GHG Emissions from Alternative MSW Generation and Management ($MTCO_2E$):	(81,234)
Incremental GHG Emissions (MTCE):	(93,597)
Total Change in Energy Use (million BTU):	(761,941)

$MTCO_2E$ = metric tons of carbon dioxide equivalent

93,597 metric tons = 206,343,000 lbs (over one year)

These environmental benefits, calculated in MTCE's, are equivalent to:

- Conserving 6,777 Households' Annual Energy Consumption
- Conserving 131,142 Barrels of Oil
- Conserving 6,095,528 Gallons of Gasoline

In addition, to calculate the volume of waste (recyclables) diverted from landfilling, for each category of recyclables, including yard waste, weight was multiplied by capture and participation rates and divided by compacted density (compacted density was employed to model diverted landfill volume).[11] These categorical volume rates in cubic yards/year were summed across all categories to arrive at a volumetric rate of 200,116 cubic yards/year of compacted recyclables diverted from the landfill.

Attachment 2 includes specific calculations and outputs.

Alternative 2: Avoided Landfill Gas Emission Calculations

As a much more limited estimate of the environmental benefits of recycling, only the avoided landfill gas emissions, through biological decomposition, were modeled. This method fails to assign any environmental benefit to recycling metals, glass, e-wastes, and only a limited benefit to plastics.

EPA WARM was again employed for the GHG emission calculations; however, the model was restricted to calculate only the GHG emissions avoided by not landfilling the Order-mandated recycling wastestreams. As in Alternative 1, individual recycling wastestreams as calculated for the municipality were entered into the best-fit material categories with landfilling (zeroed transportation values) as the only management scenario. The model calculated a yearly 19,036 metric tons of carbon dioxide equivalent or 41,967,000 pounds/year CO_2 equivalent.

[11] http://www.epa.gov/osw/conserve/tools/recmeas/docs/guide_b.pdf

9. Photovoltaic System (landfill cap)

Summary

- 1,133,100 pounds/year CO_2 equivalent

The Order covers the design and installation of an integrated geomembrane and photovoltaic power generation system applied as a closure system. When completed, the most economically viable of the evaluated systems would generate 200kW, with an annual output of some 320,400 kWh. This would result in a net reduction of some of 1,133,100 lbs of carbon dioxide equivalent in greenhouse gas emissions each year.

Explanation

The Toa Baja Landfill will incorporate a photovoltaic system into its closure design. Such a system will create a revenue stream that will offset some of the costs of closure for the Municipality and provide significant environmental benefits in the form of avoided pollution from power generation.

Landfills in Puerto Rico are particularly well suited for solar photovoltaic (PV) installation. Three different PV systems are generally considered suitable for "Brown Field"-type development: crystalline silicon (fixed tilt), crystalline silicon (single-axis tracking), and thin film (fixed tilt). The feasibility of PV systems installed on landfills is highly impacted by the available area for an array, solar resource, operating status, landfill cap status, distance to transmission lines, and distance to major roads.

The U.S. Department of Energy's National Renewable Energy Laboratory's (NREL) published the report "Feasibility Study of Economics and Performance of Solar Photovoltaics in the Commonwealth of Puerto Rico." This report presents the results of an assessment of the technical and economic feasibility of deploying a photovoltaic (PV) system on brownfield sites in the Commonwealth of Puerto Rico, including the Toa Baja Landfill. Analysts estimated the cost, performance, and site impacts of different PV options and concluded that all three options were cost-effective system in terms of return on investment at the landfill. The report recommends financing options that could assist in the implementation of such a system.

Of the NREL recommended systems, the crystalline silicon with fixed tilt appeared to offer the best combination of system payback and total output.

Toa Baja Landfill Site PV System Options[12]

[12] http://www.nrel.gov/docs/fy11osti/49237.pdf
Feasibility Study of Solar Photovoltaics on Landfills in Puerto Rico, Table 10.

System Type	Potential System Size (kW)	Annual Energy Output (kWh)	Annual Cost Savings ($)	Annual O&M[a] ($/year)	System Cost Estimates with Incentives ($)		Simple Payback Estimates (years)	
					Assuming Lower Cost[b]	Assuming Higher Cost[c]	Assuming Lower Cost[b]	Assuming Higher Cost[c]
Crystalline Silicon—Fixed Tilt	500	801,000	$104,130	$5,950	$1,125,000	$2,350,000	11	24
Crystalline Silicon—Single-axis Tracking	650	1,296,419	$168,534	$22,750	$2,175,000	$4,450,000	14	31
Thin Film—Fixed Tilt	350	560,700	$72,891	$3,808	$684,000	$1,468,000	10	21

[a] Annual O&M is based on the higher cost assumptions.
[b] $3.50/W is for a crystalline silicon fixed-tilt system. Single-axis tracking systems costs are assumed to be $5.00/W and thin-film systems are assumed to be $3.20/W.
[c] $7.00/W is for a crystalline silicon fixed-tilt system. Single-axis tracking systems costs are assumed to be $10.00/W and thin-film systems are assumed to be $6.40/W.

PV systems imbed certain amounts of greenhouse gas emission equivalents due to mining, manufacturing, transportation, and other system energy costs. The NREL estimates for GHG emissions are 48 g CO_2-eq/kWh (0.099 lbs CO_2-eq/kWh) for a Si crystalline ground-mount application under solar irradiation of 2,400 kWh/m^2/yr.[13] For the above, 801,000 kWh system, this would represent some 84,600 lbs/CO_2-eq.

Employing the EPA Greenhouse Gas Equivalencies Calculator, a thin-film PV cap system energy output of 801,000 kWh is the equivalent to 1,217,688 lbs/CO_2-eq.[14]

The net environmental benefit, in the form of avoided pollution from power generation, is 1,133,100 lbs/year CO_2 equivalent.

[13] http://onlinelibrary.wiley.com/doi/10.1111/j.1530-9290.2011.00439.x/full
Life Cycle Greenhouse Gas Emissions of Crystalline Silicon Photovoltaic Electricity Generation. Referenced by:
http://www.nrel.gov/analysis/sustain_lca_pv.html NREL*: Crystalline Silicon and Thin Film Photovoltaic Results – Life Cycle Assessment Harmonization.*

[14] http://epa.gov/cleanenergy/energy-resources/calculator.html

10. Environmental Benefit Costs

a. Capping/Closure, Leachate and Stormwater Management

- $0

The cost of maintaining compliance, closing, and capping, as well as post closure activities for the Toa Baja Landfill was captured under the prior Order.

b. Gas Collection System and Flaring/Energy Recovery Costs

- $0

This cost of designing, installing and operating a gas collection and treatment system for the Toa Baja Landfill was captured under the prior Order.

The Toa Baja gas system will likely supply methane to an end user for direct energy recovery. No cost to the owner/operator is expected.

c. Municipal Waste Recycled Costs

- $1,404,000/year

This cost estimate was based on a general municipal cost of $13,000/month of curbside recycling per 3,000 units (households) for one integrated recycling team.[15] Toa Baja, with 32,617 occupied households, with some 80% being sufficiently urban to justify curbside pick-up, would employ 9 teams at $117,000/month or $1,404,000/year.

d. Photovoltaic System (landfill cap)

- $1,737,500

The cost estimate covers the design and installation of a ground-base, fixed tilt crystalline silicon photovoltaic power generation system. The PV system estimates were based on the NREL study for Toa Baja Landfill. The system cost estimate is the average of the study's lower and higher cost estimates. Annual operation and maintenance (O&M) was not included as the annual cost savings exceeded O&M.

[15] Based on 24 Sept 2012 conversation with Efrain Camis of ConWaste, PR.

Emission Reductions and Environmental and Energy Benefits for Landfill Gas Energy Projects

For electricity generation projects, enter megawatt (MW) capacity: _____ - OR - For direct-use projects, enter landfill gas utilized by project: _____ million standard cubic feet per day (mmscfd) or 1,692 standard cubic feet per minute (scfm)

Direct Equivalent Emissions Reduced [Reduction of methane emitted directly from the landfill]		**Avoided Equivalent Emissions Reduced** [Offset of carbon dioxide from avoiding the use of fossil fuels]		**Total Equivalent Emissions Reduced** [Total = Direct + Avoided]		
$MMTCO_2E/yr$ million metric tons of carbon dioxide equivalents per year	**tons CH_4/yr** tons of methane per year	**$MMTCO_2E/yr$** million metric tons of carbon dioxide equivalents per year	**tons CO_2/yr** tons of carbon dioxide per year	**$MMTCO_2E/yr$** million metric tons of carbon dioxide equivalents per year	**tons CH_4/yr** tons of methane per year	**tons CO_2/yr** tons of carbon dioxide per year
0.1792	9,405	0.0211	23,256	0.2003	9,405	23,256
Equivalent to any one of the following annual benefits:		**Equivalent to any one of the following annual benefits:**		**Equivalent to any one of the following annual benefits:**		
Environmental Benefits		Environmental Benefits		Environmental Benefits		
• Annual greenhouse gas emissions from __ passenger vehicles:	35,131	• Annual greenhouse gas emissions from __ passenger vehicles:	4,137	• Annual greenhouse gas emissions from __ passenger vehicles:	39,268	
• Carbon sequestered annually by __ acres of pine or fir forests:	38,202	• Carbon sequestered annually by __ acres of pine or fir forests:	4,499	• Carbon sequestered annually by __ acres of pine or fir forests:	42,700	
• CO2 emissions from __ barrels of oil consumed:	416,668	• CO2 emissions from __ barrels of oil consumed:	49,065	• CO2 emissions from __ barrels of oil consumed:	465,733	
• CO2 emissions from __ gallons of gasoline consumed:	20,086,005	• CO2 emissions from __ gallons of gasoline consumed:	2,365,260	• CO2 emissions from __ gallons of gasoline consumed:	22,451,266	

Energy Benefits (based on project size entered):
• Heating __ homes: 5,750

View Calculations and References

For additional environmental benefit options, view the Greenhouse Gas Equivalencies Calculator on the EPA Clean Energy website.

Toa Baja Recycling										Order-Driven Higher Participation Rate				
									Core Recycling			Core Recycling	Core Recycling	
	Generation	Generation	Recycling	Capture	Participation	Recovery	Diversion	Diversion	Diversion	Participation	Diversion	Diversion	Diversion	
Component	(% of Total Waste)	(tons/yr)	(tons/yr)	Rate	Rate	Rate	Rate	Rate (lbs/yr)	Rate (lbs/yr)	Rate	Rate	Rate (lbs/yr)	Rate (tons/yr)	
Type 1 — Polyethylene	**0.9%**		-			0%		-	-			-	-	
Durable Goods	0.1%	41	3			0%	0.0%	-	-		0.0%	-	-	
Soft Drink Bottles	0.3%	123	10	70%	60%	42%	0.1%	229,291	229,291	84%	0.2%	321,371	160.7	
Other Plastic Containers	0.3%	123	10	50%	40%	20%	0.1%	109,186	109,186	64%	0.1%	174,958	87.5	
Other Packaging	0.1%	41	3			0%	0.0%	-	-		0.0%	-	-	
Other	0.1%	41	3			0%	0.0%	-	-		0.0%	-	-	
Type 2-HDPE	**2.8%**		-			0%	0.0%	-	-		0.0%	-	-	
Durable Goods	0.3%	123	10			0%	0.0%	-	-		0.0%	-	-	
Milk & Water Bottles	0.4%	164	13	70%	60%	42%	0.2%	305,721	305,721	84%	0.2%	428,495	214.2	
Other Plastic Containers	0.7%	286	23	50%	40%	20%	0.1%	254,768	254,768	64%	0.2%	408,235	204.1	
Trash Bags	0.1%	41	3			0%	0.0%	-	-		0.0%	-	-	
Other bags, sacks & wraps	0.4%	164	13			0%	0.0%	-	-		0.0%	-	-	
Other Packaging	0.6%	245	20			0%	0.0%	-	-		0.0%	-	-	
Other	0.2%	82	7			0%	0.0%	-	-		0.0%	-	-	
Types 3—7 (PVC, LDPE, PP, PS, Mixed)	**6.2%**		-			0%	0.0%	-	-		0.0%	-	-	
Durable Goods	3.1%	1,268	101			0%	0.0%	-	-		0.0%	-	-	
Other Plastic Containers	0.2%	82	7	50%	40%	20%	0.0%	72,791	72,791	64%	0.1%	116,639	58.3	
Plastic Plates & Cups	0.3%	123	10			0%	0.0%	-	-		0.0%	-	-	
Trash Bags (LDPE)	0.3%	123	10			0%	0.0%	-	-		0.0%	-	-	
Other bags, sacks &wraps	1.5%	614	49			0%	0.0%	-	-		0.0%	-	-	
Other Packaging	0.7%	286	23			0%	0.0%	-	-		0.0%	-	-	
High Quality Paper	1.7%	695	56	80%	60%	48%	0.8%	1,484,933	1,484,933	84%	1.1%	2,081,263	1,040.6	
Low Quality Paper	**8.7%**		-			0%	0.0%	-	-		0.0%	-	-	
Newspaper	3.2%	1,309	105	90%	70%	63%	2.0%	3,668,658	3,668,658	94%	2.7%	4,931,474	2,465.7	
Books	0.3%	123	10	50%	30%	15%	0.0%	81,890	81,890	54%	0.1%	147,661	73.8	
Magazines	0.7%	286	23	70%	50%	35%	0.2%	445,844	445,844	74%	0.4%	660,698	330.3	
Telephone Directories	0.2%	82	7	90%	30%	27%	0.1%	98,268	98,268	54%	0.1%	177,194	88.6	
Mail	1.7%	695	56	70%	40%	28%	0.5%	866,211	866,211	64%	0.8%	1,388,000	694.0	
Tissue Paper & Towels	1.0%	409	33			0%	0.0%	-	-		0.0%	-	-	
Paper Plates & Cups	0.3%	123	10			0%	0.0%	-	-		0.0%	-	-	
Milk & Juice Cartons	0.1%	41	3	50%	30%	15%	0.0%	27,297	27,297	54%	0.0%	49,220	24.6	
Other	1.2%	491	39			0%	0.0%	-	-		0.0%	-	-	
Corrugated Carton	**9.8%**	4,009	321	90%	80%	72%	7.1%	12,840,301	12,840,301	104%	9.2%	16,707,678	8,353.8	
Ferrous Metals	**11.8%**		-			0%	0.0%	-	-		0.0%	-	-	
Durable Goods Metals	9.8%	4,009	321	90%	80%	72%	7.1%	12,840,301	12,840,301	104%	9.2%	16,707,678	8,353.8	
Steel Cans	1.8%	736	59	90%	60%	54%	1.0%	1,768,817	1,768,817	84%	1.4%	2,479,151	1,239.6	
Other	0.2%	82	7	90%	60%	54%	0.1%	196,535	196,535	84%	0.2%	275,461	137.7	
Non-Ferrous Metals	**1.3%**		-			0%	0.0%	-	-		0.0%	-	-	
Beer and Soft Drink Cans	1.0%	409	33	80%	60%	48%	0.5%	873,490	873,490	84%	0.7%	1,224,272	612.1	
Foil and closures	0.3%	123	10	90%	30%	27%	0.1%	147,401	147,401	54%	0.1%	265,790	132.9	
Other	0.0%	-	-			0%	0.0%	-	-		0.0%	-	-	
Yard Waste	**19.9%**	8,141	651	90%	70%	63%	12.5%	22,814,464		94%	16.9%		-	30,667,606
Organic Waste	**11.8%**	4,827	386			0%	0.0%	-	-		0.0%	-	-	
Construction Debris	**14.6%**	5,973	478	40%	40%	16%	2.3%	4,250,984		64%	3.7%		-	
All Types Glass	2.3%		-			0%	0.0%	-	-		0.0%	-	-	
Beer & Soft Drink Bottles	1.2%	491	39	70%	60%	42%	0.5%	917,164	917,164	84%	0.7%	1,285,486	642.7	
Wine & Liquor Bottles	0.3%	123	10	60%	60%	36%	0.1%	196,535	196,535	84%	0.2%	275,461	137.7	
Food Jars	0.5%	205	16	70%	50%	35%	0.2%	318,460	318,460	74%	0.3%	471,927	236.0	
Other Durable (windows, etc.)	0.3%	123	10			0%	0.0%	-	-		0.0%	-	-	
Household Haz. Waste	0.5%	205	16	10%	30%	3%	0.0%	27,297		54%	0.0%		-	
Not Otherwise Defined	7.6%	3,109	249	50%	20%	10%	0.8%	1,383,026		44%	1.7%		-	
Total	100.0%	40,788	3,263				36%	66,219,633	37,743,862		50%	50,578,115	25,289.1	
Core Total			**Average Participation Rate =**		52%		21%			76%	28%			

EPA WARM

GHG Emissions from Baseline Management of Municipal Solid Wastes

Material	Baseline Generation of Material (Tons)	Estimated Recycling (Tons)	Annual GHG Emissions from Recycling ($MTCO_2E$)	Estimated Landfilling (Tons)	Annual GHG Emissions from Landfilling ($MTCO_2E$)
Aluminum Cans	612.1	0.0	0.0	612.1	23.8
Aluminum Ingot	132.9	0.0	0.0	132.9	5.2
Steel Cans	9,731.2	0.0	0.0	9,731.2	377.7
Copper Wire	0.0	0.0	0.0	0.0	0.0
Glass	1,016.4	0.0	0.0	1,016.4	39.5
HDPE	418.4	0.0	0.0	418.4	16.2
LDPE	58.3	NA	NA	58.3	2.3
PET	248.2	0.0	0.0	248.2	9.6
LLDPE	0.0	NA	NA	0.0	0.0
PP	0.0	NA	NA	0.0	0.0
PS	0.0	NA	NA	0.0	0.0
PVC	0.0	NA	NA	0.0	0.0
PLA	0.0	NA	NA	0.0	0.0
Corrugated Containers	8,353.8	0.0	0.0	8,353.8	12,418.1
Magazines/third-class mail	1,049.0	0.0	0.0	1,049.0	144.7
Newspaper	2,465.7	0.0	0.0	2,465.7	(1,187.4)
Office Paper	1,040.4	0.0	0.0	1,040.4	3,863.6
Phonebooks	88.6	0.0	0.0	88.6	(42.7)
Textbooks	73.8	0.0	0.0	73.8	274.2
Dimensional Lumber	0.0	0.0	0.0	0.0	0.0
Medium-density Fiberboard	0.0	0.0	0.0	0.0	0.0
Food Scraps	0.0	NA	NA	0.0	0.0
Yard Trimmings	15,333.8	NA	NA	15,333.8	3,091.2
Grass	0.0	NA	NA	0.0	0.0
Leaves	0.0	NA	NA	0.0	0.0
Branches	0.0	NA	NA	0.0	0.0
Mixed Paper (general)	0.0	0.0	0.0	0.0	0.0
Mixed Paper (primarily residential)	0.0	0.0	0.0	0.0	0.0
Mixed Paper (primarily from offices)	0.0	0.0	0.0	0.0	0.0
Mixed Metals	0.0	0.0	0.0	0.0	0.0
Mixed Plastics	0.0	0.0	0.0	0.0	0.0
Mixed Recyclables	0.0	0.0	0.0	0.0	0.0
Mixed Organics	0.0	NA	NA	0.0	0.0
Mixed MSW	0.0	NA	NA	0.0	0.0
Carpet	0.0	0.0	0.0	0.0	0.0
Personal Computers	0.0	0.0	0.0	0.0	0.0
Clay Bricks	0.0	NA	NA	0.0	0.0
Concrete	0.0	0.0	0.0	0.0	0.0
Fly Ash	0.0	0.0	0.0	0.0	0.0
Tires	0.0	0.0	0.0	0.0	0.0
Asphalt Concrete	0.0	0.0	0.0	0.0	0.0
Asphalt Shingles	0.0	0.0	0.0	0.0	0.0
Drywall	0.0	0.0	0.0	0.0	0.0
Fiberglass Insulation	0.0	NA	NA	0.0	0.0
Vinyl Flooring	0.0	NA	NA	0.0	0.0
Wood Flooring	0.0	NA	NA	0.0	0.0
Total	40,622.7	0.0	0.0	40,622.7	19,036.0